Community Composition of Phytoplankton Associated with Gulf Stream Frontal Zones and Microscale Features

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Introduction

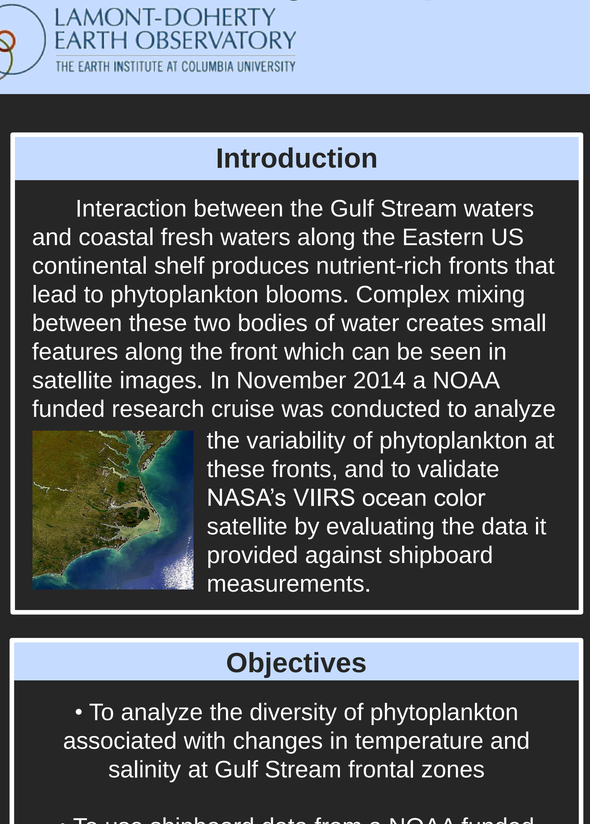
Interaction between the Gulf Stream waters and coastal fresh waters along the Eastern US continental shelf produces nutrient-rich fronts that lead to phytoplankton blooms. Complex mixing between these two bodies of water creates small features along the front which can be seen in satellite images. In November 2014 a NOAA funded research cruise was conducted to analyze the variability of phytoplankton at these fronts, and to validate NASA's VIIRS ocean color satellite by evaluating the data it provided against shipboard measurements.

Objectives

- To analyze the diversity of phytoplankton associated with changes in temperature and salinity at Gulf Stream frontal zones

- To use shipboard data from a NOAA funded research cruise in November 2014 to validate the VIIRS ocean color satellite

Phytoplankton Groups



Acknowledgements

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Data Sets and images downloaded from the NASA Ocean Color Website

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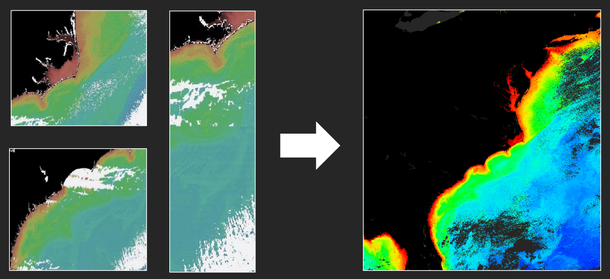
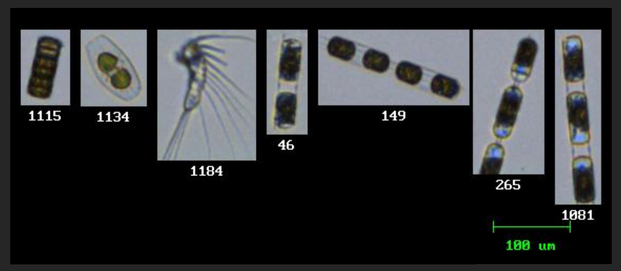
Methods

1 Individual satellite swaths were binned to create high resolution daily and 3-day composite averages of sea surface temperature (SST), chlorophyll-a, and Kd490 (vertical attenuation coefficient and a proxy for salinity).



2 Chlorophyll-a, SST, and Kd490 values were extracted from these images along the cruise track and matched up with the corresponding in situ measurements.

3 Satellite measured chlorophyll peaks were selected from the data, and FlowCam images of phytoplankton from water samples collected at these locations were sorted into groups.



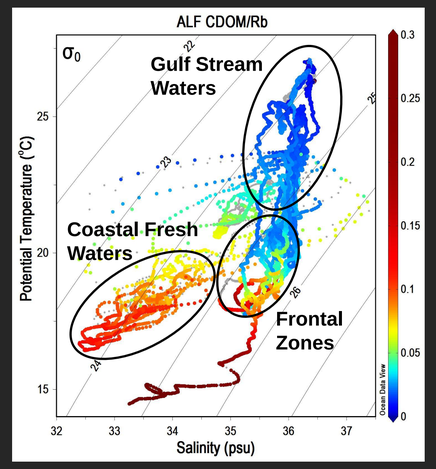
4 Temperature vs. salinity plots were made to distinguish the body of water in which phytoplankton groups live, and to define a relationship between the health of the cells and the water conditions.

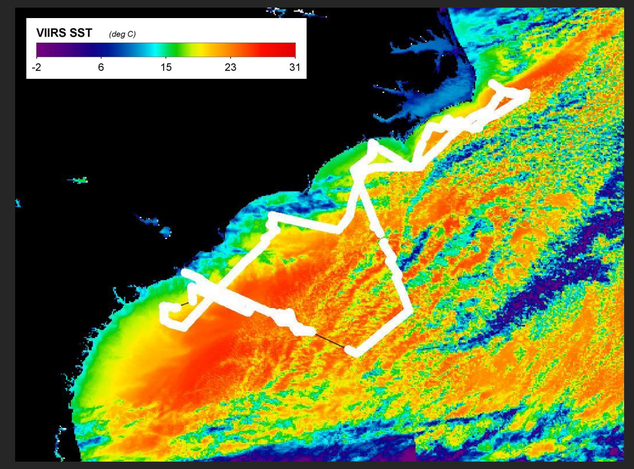
	Chlorophyll	SST	Salinity	Phytoplankton Composition
In Situ	✓	✓	✓	✓
Remote Sensing	✓	✓	✓	

Results

Where are the frontal zones?

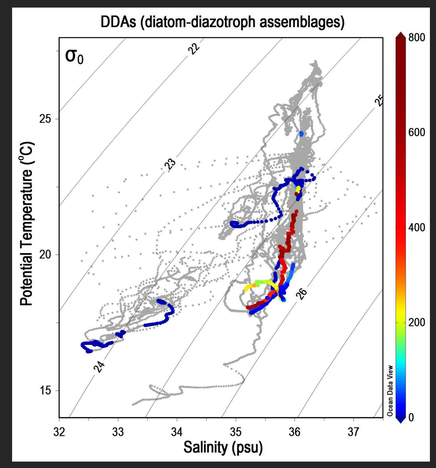
Color Dissolved Organic Matter (CDOM), like Kd490, has an inverse relationship with salinity. This T/S plot shows where the frontal zones are by density. These fronts, as well as microscale features along the front, can also be seen in SST satellite images.

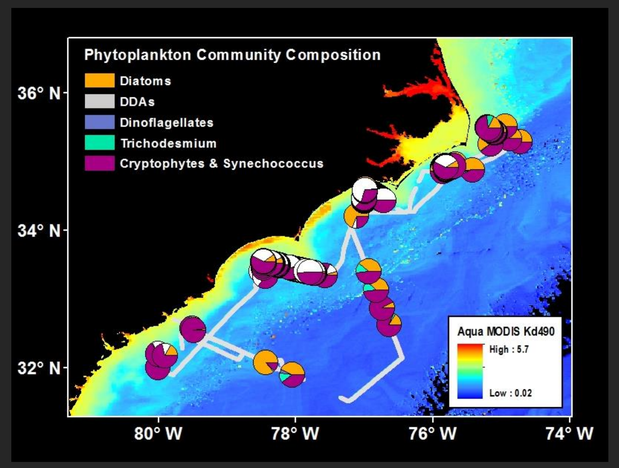




Where do the phytoplankton reside?

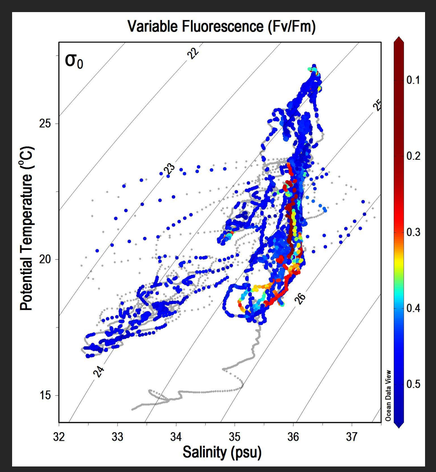
Diatom blooms appear near the coastal waters, where nutrients are available in large concentrations. DDAs appear at the end of the Diatom bloom when nitrogen is depleted, but silicate is still present in the water. Cryptophytes and Synechococcus appear in high salinity waters that are devoid of nutrients.





How healthy are the cells?

Variable fluorescence is an estimate of photosynthetic activity. Low levels (shown in red) reveal an unhealthy population of phytoplankton.



Conclusions

- While the VIIRS satellite chlorophyll data matched up with the in situ data, the ability of the satellite to capture microscale features was compromised by storms during the cruise period.

- The Diatom cluster at the northeastern end of the cruise track corresponds with heavy river outflow from the continent, which brings fresh water, nutrients, and organic carbon to the area.

- DDAs, the symbiotically associated Diatom-N_2 fixing assemblages, are most populous in the frontal zones where mesohaline conditions prevail.

- Low variable fluorescence frontal regions are indicative of an unhealthy population due to nutrient depletion, and are coincident with the appearance of DDAs and their N_2 fixing symbionts.